NUI Galway
OÉ Gaillimh

Autumn Examinations 2017 / 2018

Exam Code(s)	4BCT1, 4BP1
Exam(s)	B.Sc. Degree (Computer Science & Information Technology) Bachelor of Engineering (Electronic and Computer Engineering)
Module Code(s)	CT417
Module(s)	Software Engineering III
Paper No.	1
External Examiner(s)	Dr. Jacob Howe
Internal Examiner(s)	Prof. Michael Madden *Dr. Sam Redfern *Dr. Michael Schukat

Instructions: Answer question 1 (mandatory) and any 3 other questions.
Answer 4 questions in total.
All questions carry equal marks.

Duration	2hrs
No. of Pages	6 (Including cover page)
Department(s)	Information Technology
Requirements	None

Question 1 is mandatory

Q1. (20 marks)

Consider a typical web-based application: an online shop. The application must track users, products, stock levels and completed sales.

(a) Describe at a high level (and with the aid of a diagram) a layered (n-Tier) architecture design which would meet the basic requirements of the system. Include a brief list of typical responsibilities for each layer.

8 Marks

(b) Describe the logic and information flows through the system according to these two use cases:

(i) A previously registered user logs in and is presented with the shop's home page.

(ii) A user searches for an item by name, and is presented with a page of results. **4 Marks**

(c) Assume that the online shop becomes incredibly successful and has to deal with an increasing number of transactions per second.

(i) Where are the most serious bottlenecks in the system likely to occur?

(ii) Describe an alternative software architecture which could be used to alleviate these bottlenecks (there are several to choose from).

(iii) Briefly, what new challenges would this architecture bring?

8 Marks

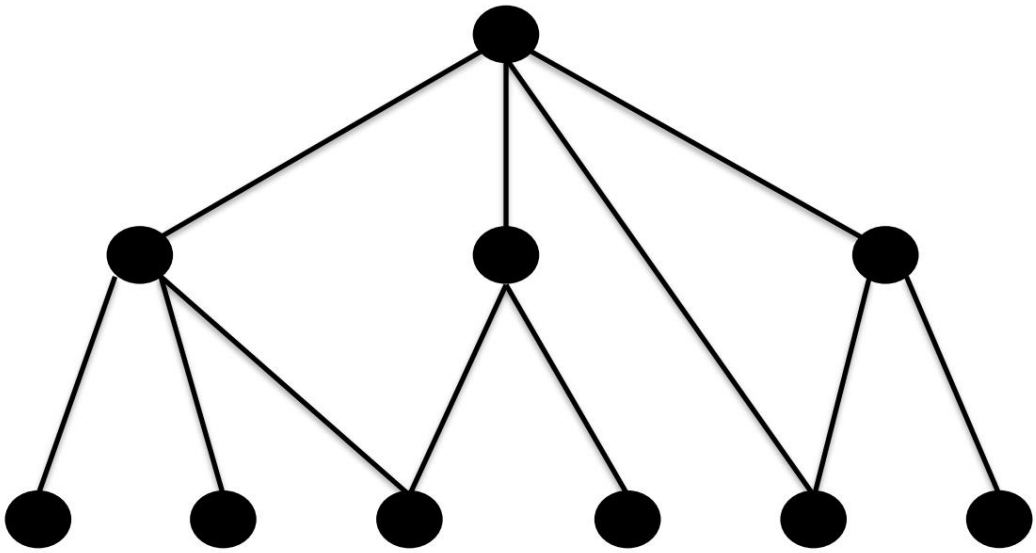
Q2. (20 marks)

(a) Identify the spanning tree for the following software module design, and calculate the values for Tree Impurity (m(G)) and Internal Reuse (r(G)).

Remember:

$$m(G) = \frac{number\ of\ edges\ more\ than\ the\ spanning\ tree}{maximal\ number\ of\ edges\ more\ than\ the\ spanning\ tree}$$

$$r(G) = number\ of\ edges\ additional\ to\ the\ spanning\ subtree$$



8 Marks

(b) Explain why tree impurity m(G) is a useful measure for assessing the potential quality of a software architecture.

4 Marks

(b) Draw the following labelled flowgraphs:

- **D_1 ; D_3**
- **$D_1(D_2)$**

Include the corresponding pseudocode for each of the program constructs.

8 Marks

Q3. (20 marks)

(a) What is meant by the *Response for a class* (RFC)?
Calculate the RFC for the class *classA* as shown below:

```
public class ClassA
{
  private ClassB classB = new ClassB();
  public void doSomething(){
    System.out.println ( "doSomething");
  }
  public void doSomethingBasedOnClassB(){
    System.out.println (classB.toString());
  }
}


public class ClassB
{
  private ClassA classA = new ClassA();
  public void doSomethingBasedOneClassA(){
    System.out.println (classA.toString());
  }

  public String toString(){
    return "classB";
  }
}
```

8 Marks

(b) Distinguish between the terms *branch coverage* and *line coverage*.

2 Marks

Further on, for the following code example calculate the branch and line coverage produced by a test where isLoggedIn is set to true:

```
public void loginStatus(boolean isLoggedIn)
{
        if(isLoggedIn)
        {
                System.out.println("User is logged in");
        }
        else
        {
        System.out.println("User is not logged in");
        }
}
```

6 Marks

(c) In Agile, what is the purpose of a Burndown Chart? Use a diagram to illustrate your answer. **4 Marks**

Q4. (20 marks)

(a) In measurement theory, discuss the difference between direct and indirect measurements.

3 Marks

(b) Describe, using examples, the following object-oriented measures:

- Coupling between objects
- Weighted methods per class
- Specialisation Index

6 Marks

(c) Briefly summarise the *Jelinski-Moranda* (JM) model and argue why it is suitable as a model of software reliability growth. In your answer clearly show the formulation for the hazard rate.

3 Marks

Further on, assuming that the initial number of faults N in the system is 8, and φ = 0.005 (with φ being the contribution of each fault to the failure rate), predict the MTTF for the system after each of 6 successive system repairs.

8 Marks

Q5. (20 marks)

(a) Use the box plot method to identify outliers in the following data set for fault density (FD) in a range of software systems. Sketch the boxplot, showing the median, 1st and 3rd quartiles, upper and lower tails and the outliers:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	12	13	15	15	16	16	18	18	20	21	21	21	22	24	34	35	36

6 Marks

PTO

(b) For the following class, calculate the Lack of Cohesion of Methods (LCOM) Measure:

```
class Account
{
        String id;
        double balance;
        double RATE = 1.11;

        public getID(){ return this.id; }

        public getBalance(){ return this.balance; }

        public credit(double amt)
        {
                this.balance += amt;
        }

        public debit(double amt)
        {
                this.balance -= amt;
        }

        public getExchangeRate(){ return this.RATE; }

        public setExchangeRate(double v)
        {
                this.RATE = v;
        }
}
```

10 marks

(b) Discuss the result, and comment on the strengths and weaknesses of the LCOM approach.

4 Marks